SIZE AT METAMORPHOSIS OF THE FROG *HYLA AUREUS RANIFORMIS* (KEFERSTEIN).

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(One Text-figure.)

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Synopsis.

A series of the frog *Hyla aureus raniformis* (Keferstein) from Gippsland, Victoria, was examined and conclusions were drawn as to size at metamorphosis and the stage at which tadpoles left the water. There appears to be a normal course of metamorphosis followed by about 75 per cent of frogs, but for the remainder an unknown cause postpones development.

A new name is given to a subspecies of *Hyla ewingii.*

The finding of a fairly large series of the frog *Hyla aureus raniformis* Keferstein at a restricted locality in Victoria has afforded an opportunity to record details of the stage at which individuals of this subspecies complete metamorphosis. All 51 specimens were collected two miles south of Hill End on the Moe Road on 28.xii.1961. They were in a stack of galvanized iron sheets together with battens and other lengths of wood which kept the approximately 6 by 2½ feet sheets of iron apart, and formed ample sheltering space for scores of frogs. Many dried skeletons showed where frogs had been crushed to death when the pile shifted. The site was separated by about 20 ft. of mainly boggy, well-grassed ground from a large artificial pond or dam.

Plotting of the tail length against combined head and body length on a scatter-diagram showed two apparently well-defined groups. The first, which includes 40 frogs (approximately 78 per cent), is spaced about the curve to the left and bottom. It reflects, I believe, the normal pattern of size during metamorphosis: at least for one population at one locality in southern Victoria at mid-summer. The continual and gradual reduction of the tail is followed from individuals of from 14 to 16 mm. head and body length, which were the smallest found on land, to completely or practically completely metamorphosed young frogs about 25 or 26 mm. in head and body length. This normal curve would be even more pronounced if some of the 1 mm. tail readings were taken as zero. This is certainly so in some cases where the figure for tail length should more properly represent the short coccygeal protuberance normal in the adult.

The second group, including 11 frogs (approximately 22 per cent), lies to the upper right and consists of those specimens whose measurements are plotted within the line of small open circles. It represents that section of the metamorphosing individuals in which normal activity of the thyroid, or its instigator the pituitary, has been delayed and the tadpoles or rather young frogs have continued to increase in head and body length without the normal relative reduction in the length of the tail.

The reason for these two different courses in metamorphosis is unknown. Conditions of light and temperature which are known to affect the production of hormones by the pituitary and thyroid would be expected to be uniform for all the frogs. So other factors must operate. Similar problems arise with other controls, such as why rain triggers off breeding in the entire population of many species of frogs at once and practically simultaneously, while in others, although it starts breeding, this is spread over weeks or months. An instance of the urgency with which frogs begin breeding was shown by a storm over a dry area in Queensland on January 12, 1955. At least eight species of frogs were found mating in a shallow pond three hours after the first rain fell.

It will be noted that few small specimens are recorded to the left of the diagram. It is probable that metamorphosing individuals with a head and body length of much less than 14 mm. do not leave the water. No smaller specimens were seen on land in spite of the ideal damp to wet conditions found at the bottom of the stack, which also was close to water. Again, frogs would almost certainly seek shelter from birds and other predators as soon as possible. The dam had some bordering reeds and other vegetation, but the greater part was exposed.

The following specimens in the author's collection were examined: Nos. 7513–7532, 7534, 7535, 7538–7548, 7550, 7551, 7553–7555, 7557, 7558, 7560, 7561, 7565, 7567, 7575, 7576, 7578, 7580, 7581, 7586, 7599.

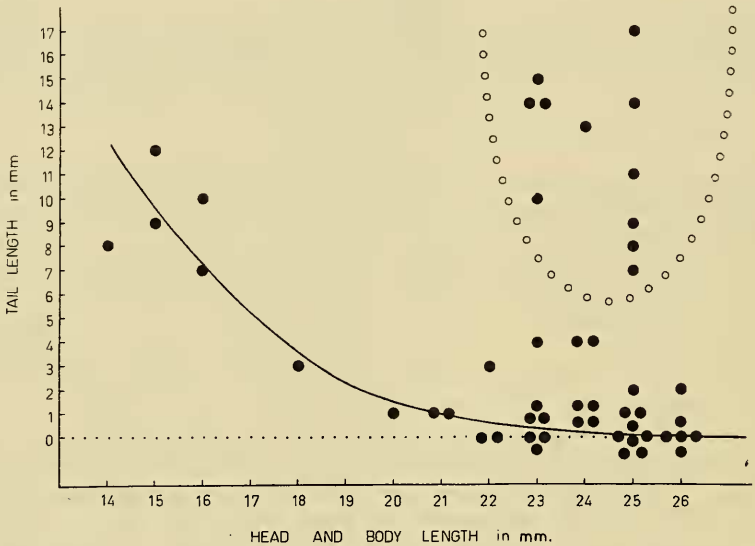

Fig. 1.—Diagram in which the tail lengths of the 51 individuals examined are plotted against the combined head and body lengths. Each black dot represents one frog. The normal distribution curve of size during metamorphosis is shown to the left and bottom. Forty of the 51 specimens follow this pattern. The 11 dots to the top right contained within the open circles indicate delayed metamorphosis.

Particulars of tail lengths arranged under head and body lengths follow: head and body length; 14 mm.: tail length, one 8 mm.; 15: one 12, one 9; 16: one 10, one 7; 18: one 3; 20: one 1; 21: two 1; 22: one 3, two 0; 23: one 15, two 14, one 10, one 4, three 1, three 0; 24: one 13, two 4, four 1; 25: one 17, one 14, one 11, one 9, one 8, one 7, one 2, two 1, six 0; 26; one 2, five 0. The pattern of distribution of these measurements is shown in the Text-figure.

I have to thank the following authors, whose research was consulted: Goin and Goin, Moore, Noble, and Wright and Wright. Their works are listed below. I am grateful to my daughters Janet and Christina for helping me collect the frogs on which this paper is based.

References.

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Noble, G. K., 1931.—Biology of the Amphibia. New York: 1-577.

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A New Name in Hyla ewingii.

Dr. Richard G. Zweifel, of the American Museum of Natural History, has kindly informed me that in his 1958 paper on *Nyctimystes* (1958: Amer. Mus. Nat. Hist., Novitate no. 1896: 43) he transferred W. T. Neill's 1954 (1954: *Copeia* (2): 83) species *Nyctimystes loveridgei* to the genus *Hyla*. Accordingly my *Hyla ewingii loveridgei* (1957: Proc. Linn. Soc. N.S.W., 82 (1): 65) needs a new name. I now replace the old one with *Hyla ewingii oberonensis*. Oberon at an elevation of 3,623 ft. is the nearest town of any size to the type locality Porter's Retreat, which is about 20 miles away. Also the subspecies is common in the Oberon area.